ECS 235B Module 39
Policy Composition

Composition of Policies

- Two organizations have two security policies
- They merge
  - How do they combine security policies to create one security policy?
  - Can they create a coherent, consistent security policy?

The Problem

- Single system with 2 users
  - Each has own virtual machine
  - Holly at system high, Lara at system low so they cannot communicate directly
- CPU shared between VMs based on load
  - Forms a *covert channel* through which Holly, Lara can communicate

Example Protocol

- Holly, Lara agree:
    - Begin at noon
    - Lara will sample CPU utilization every minute
    - To send 1 bit, Holly runs program
        - Raises CPU utilization to over 60%
    - To send 0 bit, Holly does not run program
        - CPU utilization will be under 40%
- Not “writing” in traditional sense
    - But information flows from Holly to Lara

Policy vs. Mechanism

- Can be hard to separate these
- In the abstract: CPU forms channel along which information can be transmitted
  - Violates *-property
  - Not “writing” in traditional sense
- Conclusion:
  - Bell-LaPadula model does not give sufficient conditions to prevent communication, *or*
  - System is improperly abstracted; need a better definition of “writing”

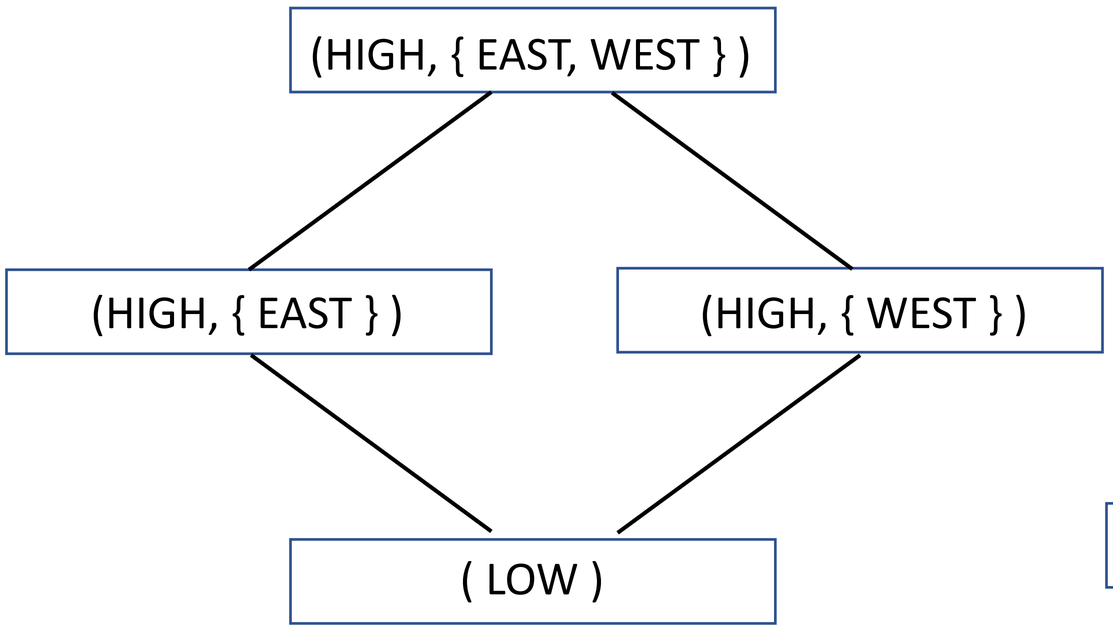
Composition of Bell-LaPadula

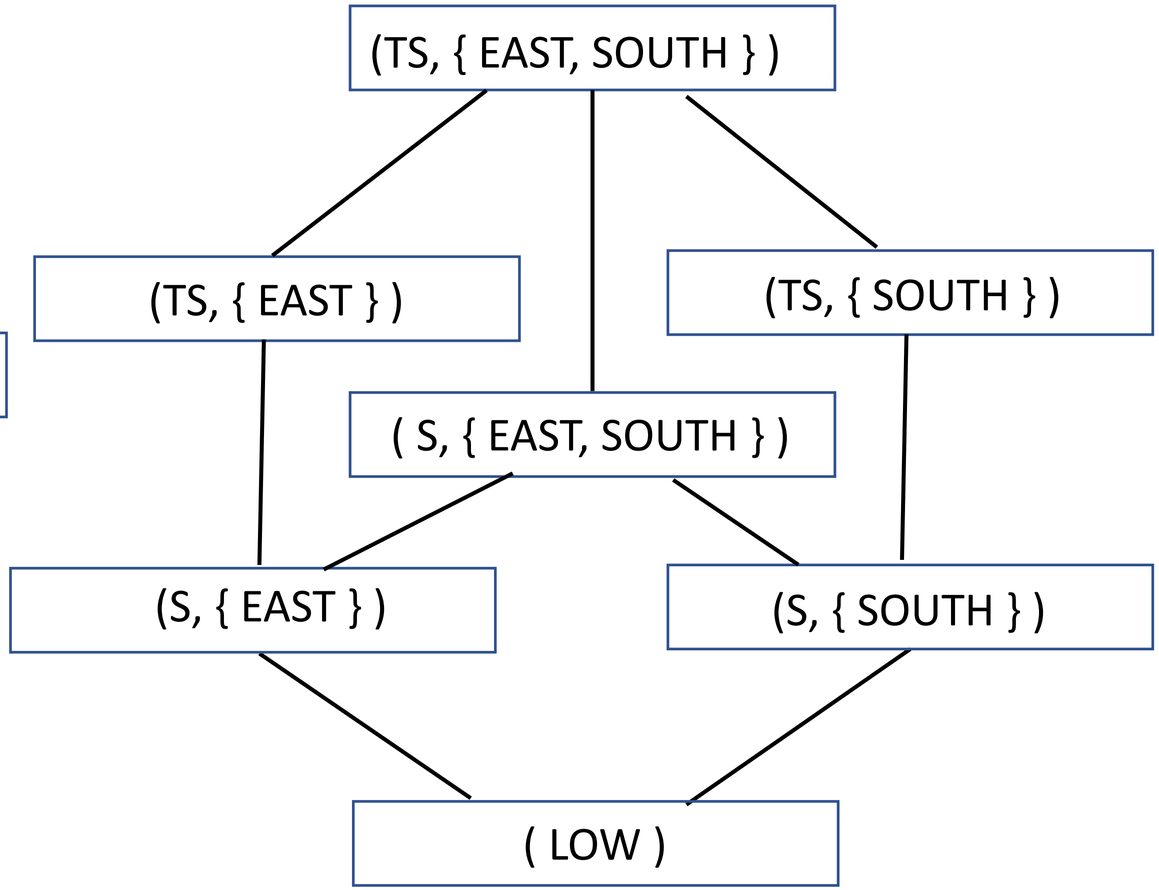
- Why?
  - Some standards require secure components to be connected to form secure (distributed, networked) system
- Question
  - Under what conditions is this secure?
- Assumptions
  - Implementation of systems precise with respect to each system's security policy

Issues

- Compose the lattices
- What is relationship among labels?
    - If the same, trivial
    - If different, new lattice must reflect the relationships among the levels

Example


(HIGH, { EAST, WEST })
(HIGH, { EAST })
(HIGH, { WEST })
(LOW)


(TS, { EAST, SOUTH })
(TS, { EAST })
(TS, { SOUTH })
(S, { EAST, SOUTH })
(S, { EAST })
(S, { SOUTH })
(LOW)

Analysis

- Assume S < HIGH < TS
- Assume SOUTH, EAST, WEST different
- Resulting lattice has:
    - 4 clearances (LOW < S < HIGH < TS)
    - 3 categories (SOUTH, EAST, WEST)

Same Policies

- If we can change policies that components must meet, composition is trivial (as above)
- If we *cannot*, we must show composition meets the same policy as that of components; this can be very hard

Different Policies

- What does “secure” now mean?
- Which policy (components) dominates?
- Possible principles:
  - Any access allowed by policy of a component must be allowed by composition of components (*autonomy*)
  - Any access forbidden by policy of a component must be forbidden by composition of components (*security*)

Implications

- Composite system satisfies security policy of components as components' policies take precedence
- If something neither allowed nor forbidden by principles, then:
    - Allow it (Gong & Qian)
    - Disallow it (Fail-Safe Defaults)

Example

- System X: Bob can’t access Alice’s files
- System Y: Eve, Lilith can access each other’s files
- Composition policy:
    - Bob can access Eve’s files
    - Lilith can access Alice’s files
- Question: can Bob access Lilith’s files?

Solution (Gong & Qian)

- Notation:
  - (*a*, *b*): *a* can read *b*’s files
  - AS(*x*): access set of system *x*
- Set-up:
  - AS(X) = ∅
  - AS(Y) = { (Eve, Lilith), (Lilith, Eve) }
  - AS(X∪Y) = { (Bob, Eve), (Lilith, Alice), (Eve, Lilith), (Lilith, Eve) }

Solution (Gong & Qian)

- Compute transitive closure of AS(X$\cup$Y):
  - AS(X$\cup$Y)$^+$ = { (Bob, Eve), (Bob, Lilith), (Bob, Alice), (Eve, Lilith), (Eve, Alice), (Lilith, Eve), (Lilith, Alice) }
- Delete accesses conflicting with policies of components:
  - Delete (Bob, Alice)
- (Bob, Lilith) in set, so Bob can access Lilith’s files

Idea

- Composition of policies allows accesses not mentioned by original policies
- Generate all possible allowed accesses
  - Computation of transitive closure
- Eliminate forbidden accesses
  - Removal of accesses disallowed by individual access policies
- Everything else is allowed
- Note: determining if access allowed is of polynomial complexity

Quiz

Which of the following principles does the Gong and Qian method of composing policies best fit?

1. That which is not explicitly allowed is forbidden
2. If either policy allows an access, the composition allows the access
3. If either policy disallows an access, the composition disallows the access
4. If the policies being composed say nothing about an access (neither allowed nor forbidden), the access is forbidden